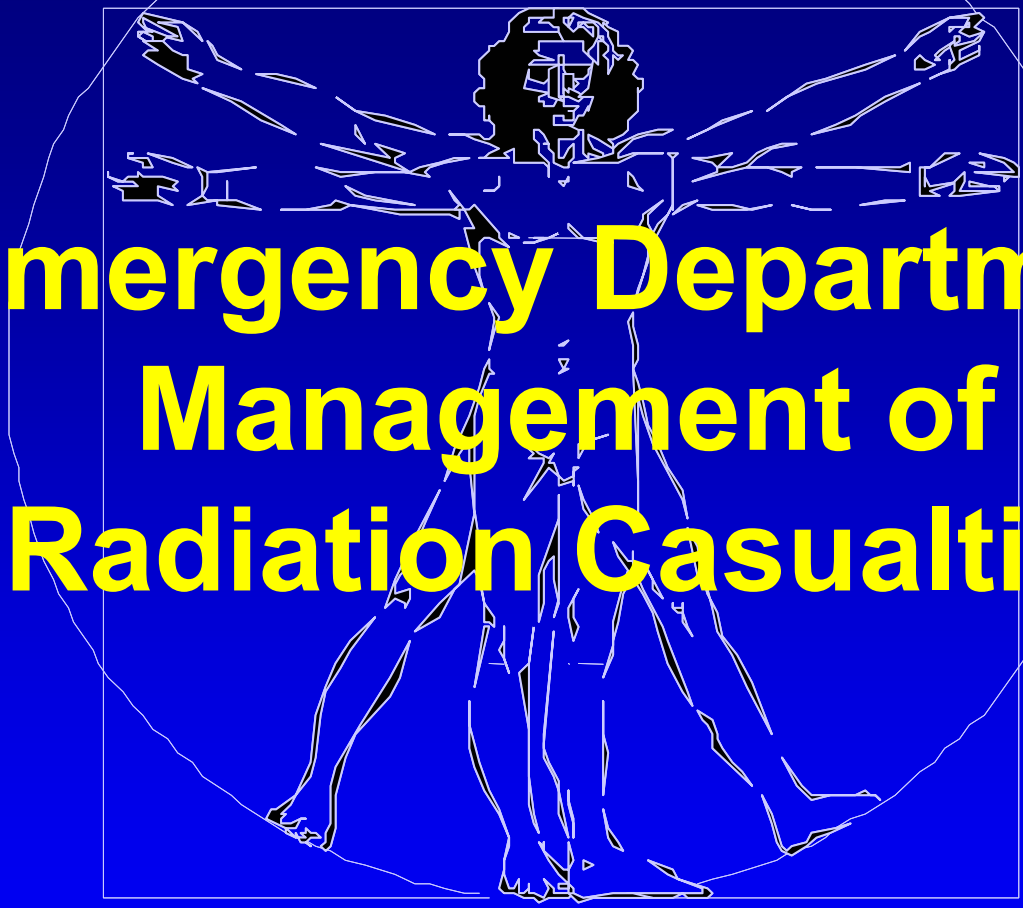


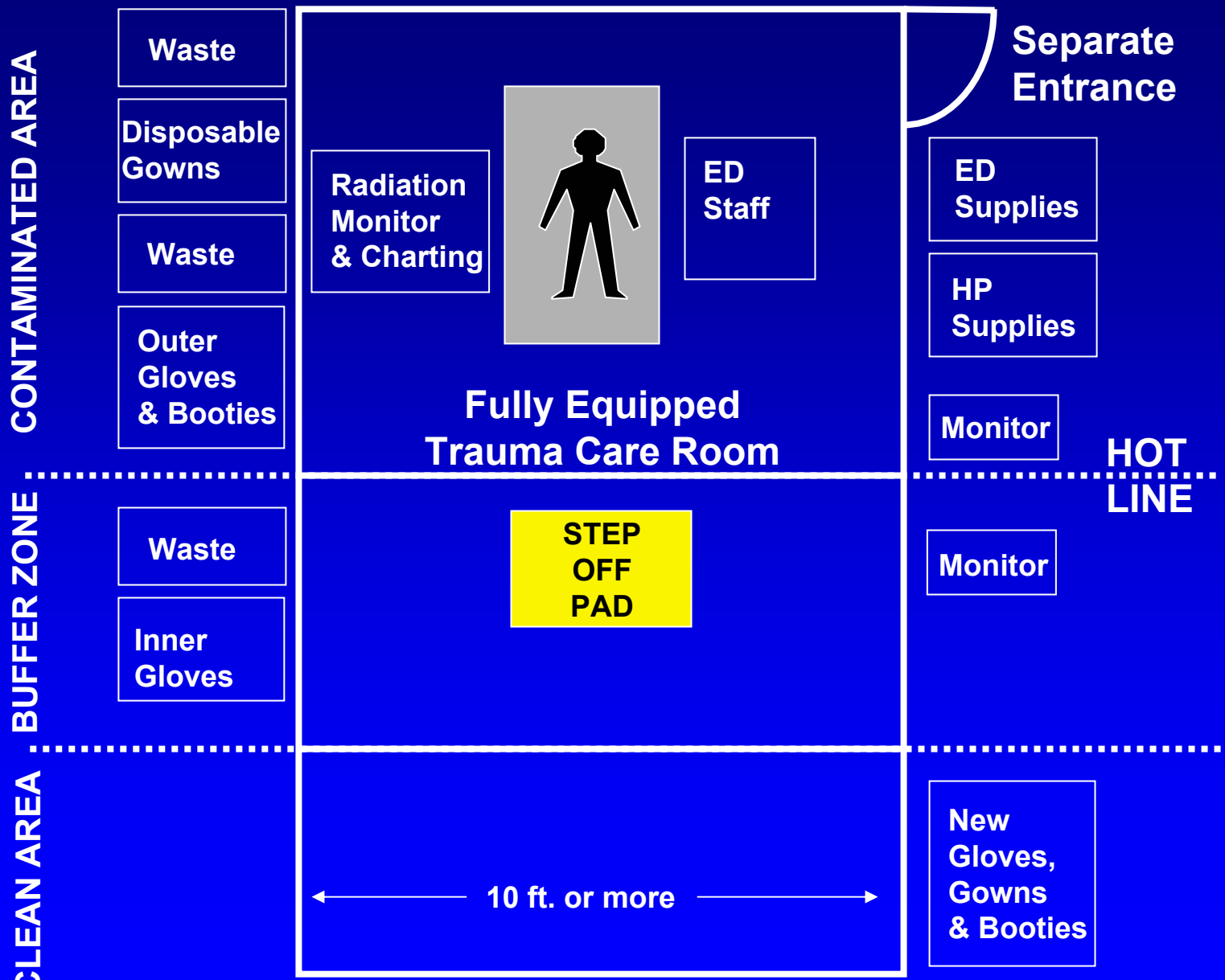
Emergency Department Management of Radiation Casualties

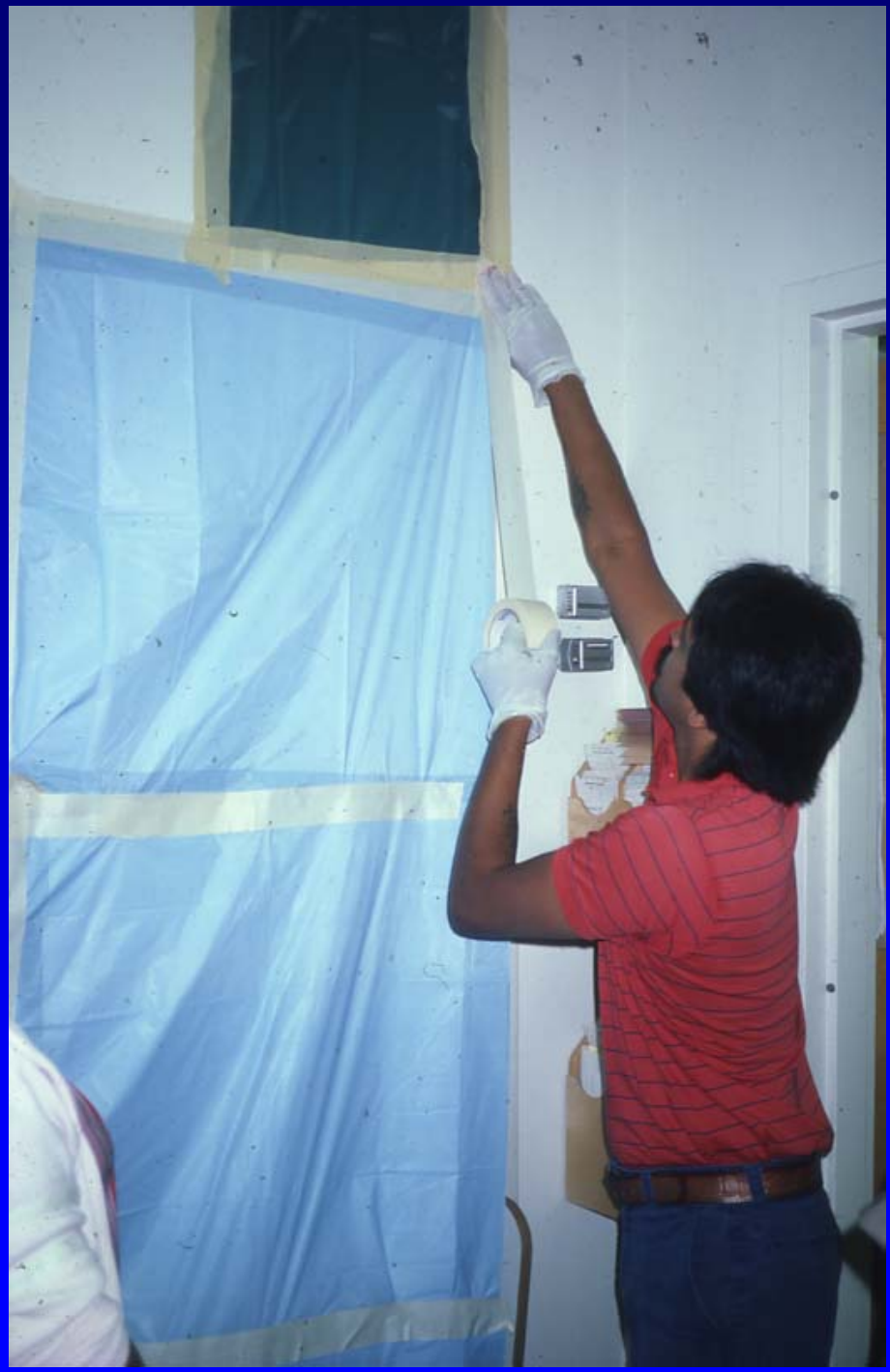
Dr. Jerrold T. Bushberg
Clinical Professor, Radiology
Director of Health Physics Programs
University of California, Davis

HOSPITAL STAFFING

- Nursing
- Emergency Physician
- Radiation Safety
- Housekeeping or Engineering
- Security
- Administration
- Public Relations

TREATMENT AREA LAY-OUT






RADIOACTIVE
MATERIAL

ANDERSON'S LAW

I have yet to see any problems, however complicated, which, when looked at in the right way, cannot be made more complicated.

DECONTAMINATION TEAM PREPARATION

- Clip on TLD/film badge (waist level)
- Don full surgical dress, including
  - Surgical trousers and overshirt
  - Surgical hood and mask
  - Two pair disposable gloves (tape first pair to sleeve cuff)
  - Waterproof shoe covers
- Attach self reading dosimeter to outside collar

Self Reading Dosimeters


SAN FR
CAUTION
HIGH RADIATION
AREA

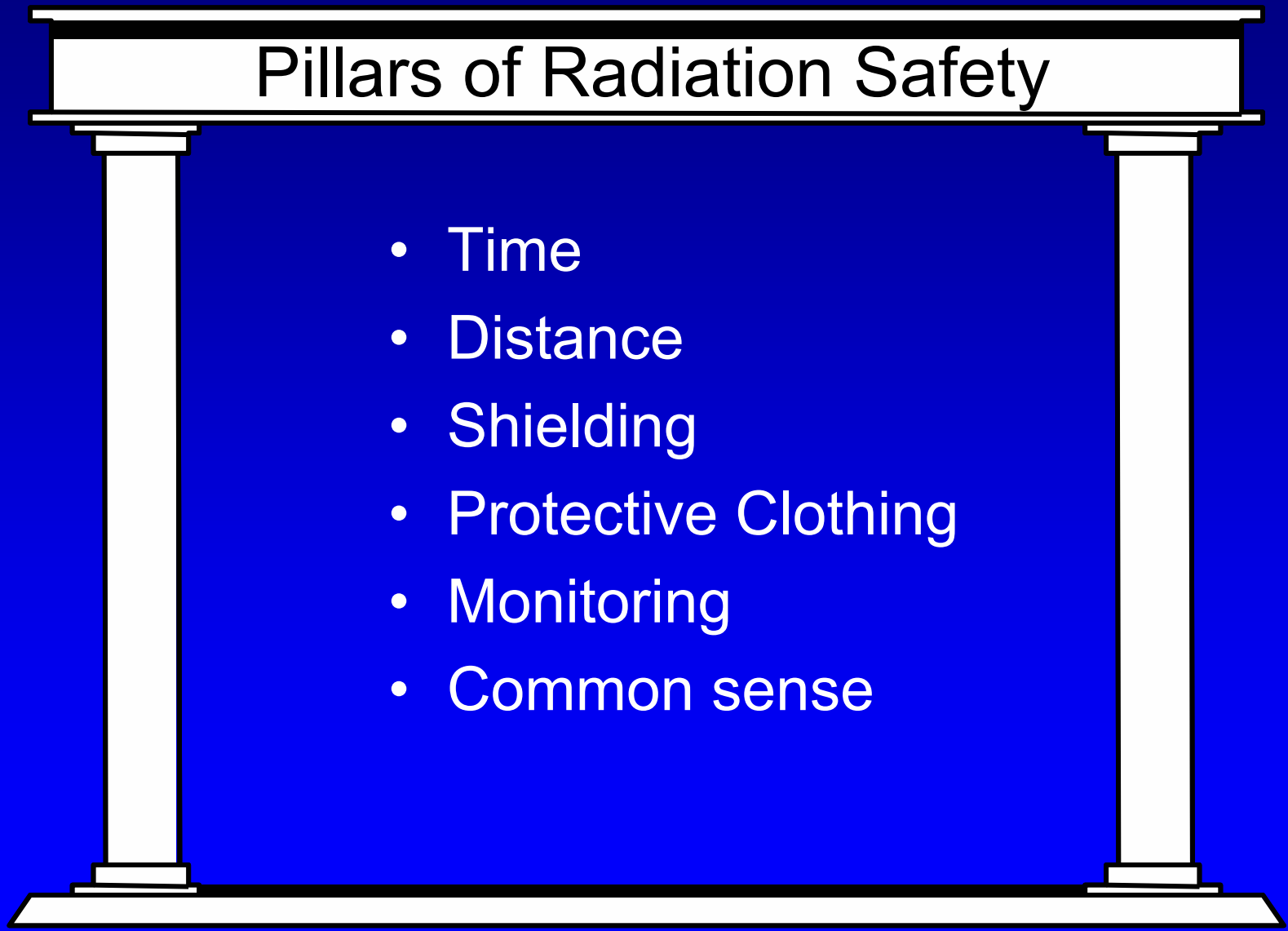
JARGON DIFFICULTIES

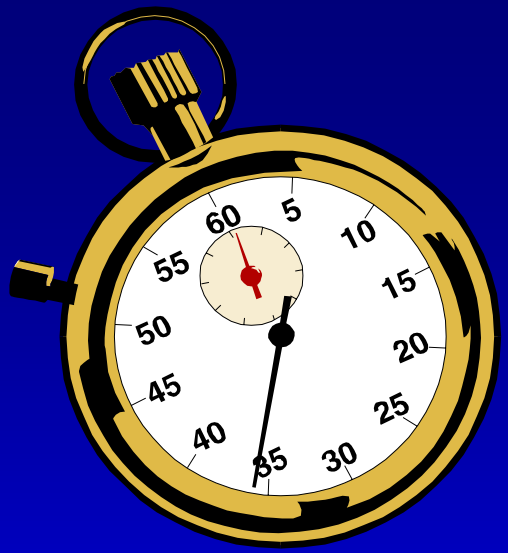
Health Physics	Medical
dpm	ABC
HVL	MRA
TLD	DOE
erg	SOB
pCi	KUB
mR	ECG

MEDICAL PRIORITIES FOR RADIATION CASUALTIES

- ABC
- Stabilization
- Prevent external contamination from becoming internal
- Consider possible therapy for internal contamination
- Prevent local external contamination from becoming generalized
- Symptomatic therapy for overexposure

RADIATION PROTECTION





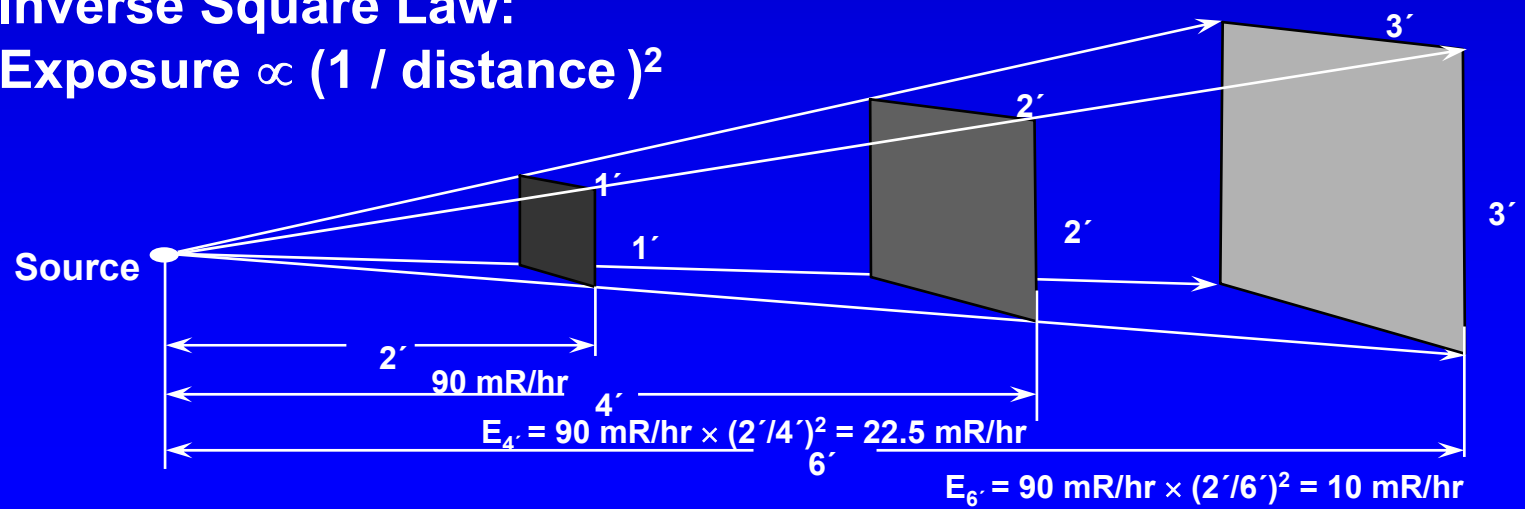
TIME AND EXPOSURE

- Have all necessary materials
- Adequate training to assure proficiency

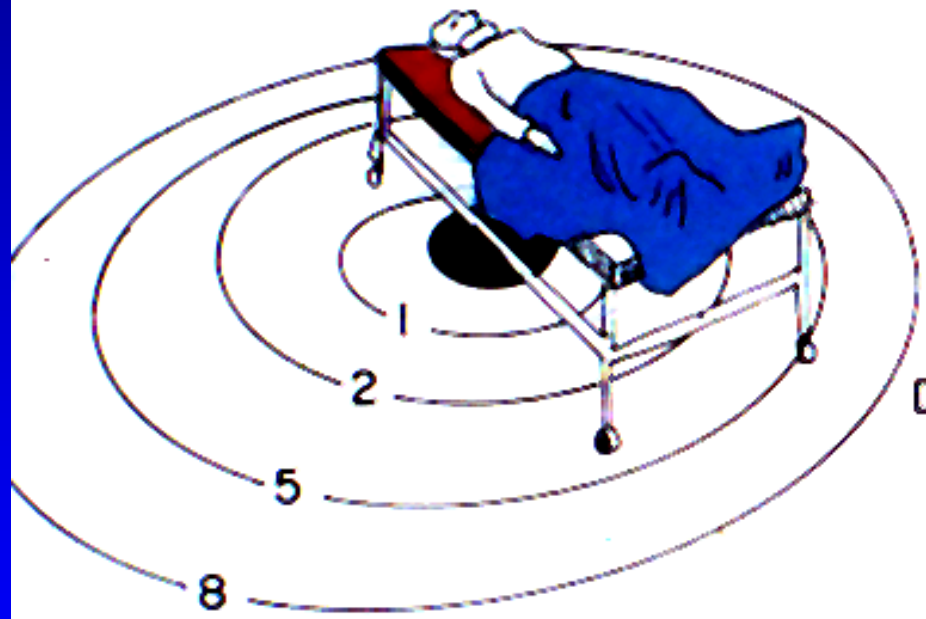
DISTANCE AND RADIATION EXPOSURE

- More effective than time
- More practical than shielding

Inverse Square Law:
Exposure ∝ (1 / distance)^2



ATTENDANT PROTECTION DISTANCE



DISTANCE	DOSE RATE	STAY TIME
1 FT.	12.5 R/hr.	24 min.
2 FT.	3.1 R/hr.	1.6 hr.
5 FT.	0.50 R/hr.	10 hr.
8 FT.	0.20 R/hr.	25 hr.

PROTECTION PROVIDED BY 0.5 mm LEAD APRON

Source	Energy (kev)	Attenuation with 1 apron	# aprons per HVL	Weight (lbs)
Scattered x-ray	10-40	>90%	–	~10
Ir-192	317	~14%	4.6	~50
Cs-137	662	~6%	11.2	>100


CAUTION
CONTAMINATED AREA
PROTECTIVE CLOTHING
REQUIRED FOR ENTRY
DOSE RATE
MR/HR
SPECIAL INSTRUCTIONS
CONTAMINATION
CPM DPM
AIRBORNEACTIVITY
UC/CC
RWP
POSTED BY
DATE
©NSS

Decontamination Procedures

- Remove patient's clothing
- Wash patient with soap and water

95% EFFECTIVE

WTT48


CAUTION

INTERNAL CONTAMINATION

- DO NO HARM
- HAZARD DEPENDS UPON
  - RADIONUCLIDE(S)
  - PORTAL OF ENTRY
  - SOLUBILITY IN H_20
  - CHEMISTRY
  - PARTICLE SIZE & SHAPE
  - EFFECTIVE HALF LIFE
  - ESTIMATED TEDE

Pathways into Body

Inhalation
Ingestion
Absorption
Puncture

SPECIFIC MEASURES TO MANAGE INTERNAL CONTAMINATION

- **Minimize absorption**
  - wound irrigation and debridement
  - prevent cross contamination
- **Enhance elimination**
  - target organ blocking
  - dilution/diuresis
  - chelation therapy
  - binding agents
  - gastric lavage and purgation

EMERGENCY TREATMENTS FOR INTERNAL CONTAMINATION

Source	Treatment
Iodine-131	Thyroid blocking (SSKI)
Tritium (H-3)	Water diuresis
Strontium-90	Phosphates, alginate gel
Cesium-137	
Manganese-54	Gastric lavage, purgatives
Cobalt-60	
Plutonium-239	Chelating agents (e.g. DTPA)
Americium-241	
Iridium-192	Penicillamine, diuresis


NDC 0037-0472-20
THYRO-BLOCK ™ Tablets
[Potassium Iodide Tablets, USP]
14 TABLETS

KI Dosing Schedule
"Thyro-Block"

Adults	**130 mg KI/day**
Children	
3 - 18 yrs	**65 mg KI/day**
1 mo - 3 yrs	**32 mg KI/day**
0 - 1 mo	**16 mg KI/day**

World Health Organization, Geneva, Guidelines for Iodine Prophylaxis Following Nuclear Accidents: Update 1999.

Treatment of Radioiodine Contamination

Time given	% Effectiveness
Prior to contamination	100
Immediately after contamination	90
4 hours after contamination	50
24 hours after contamination	0

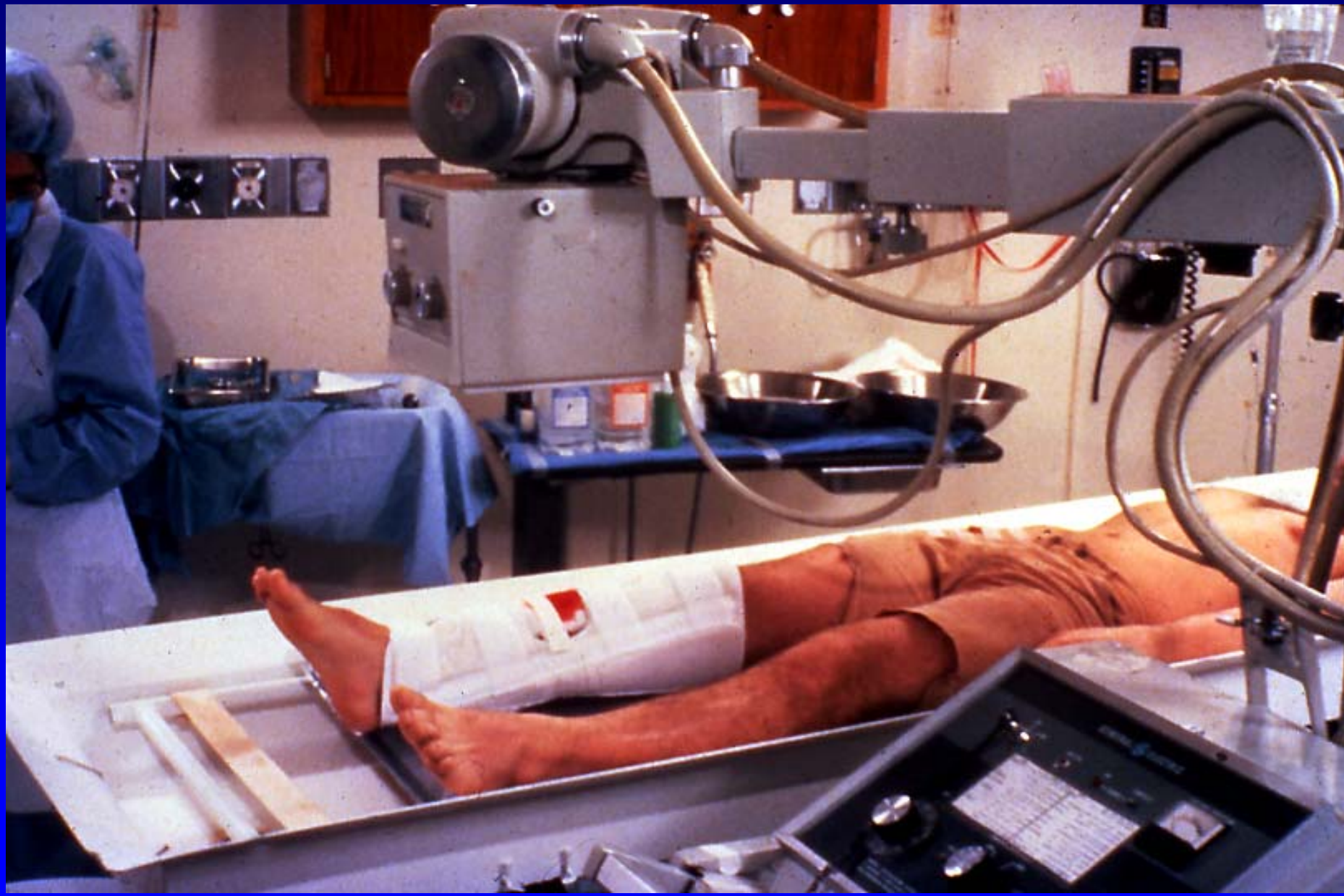
NCRP REPORT No. 65

MANAGEMENT OF PERSONS ACCIDENTALLY CONTAMINATED WITH RADIONUCLIDES

NCRP

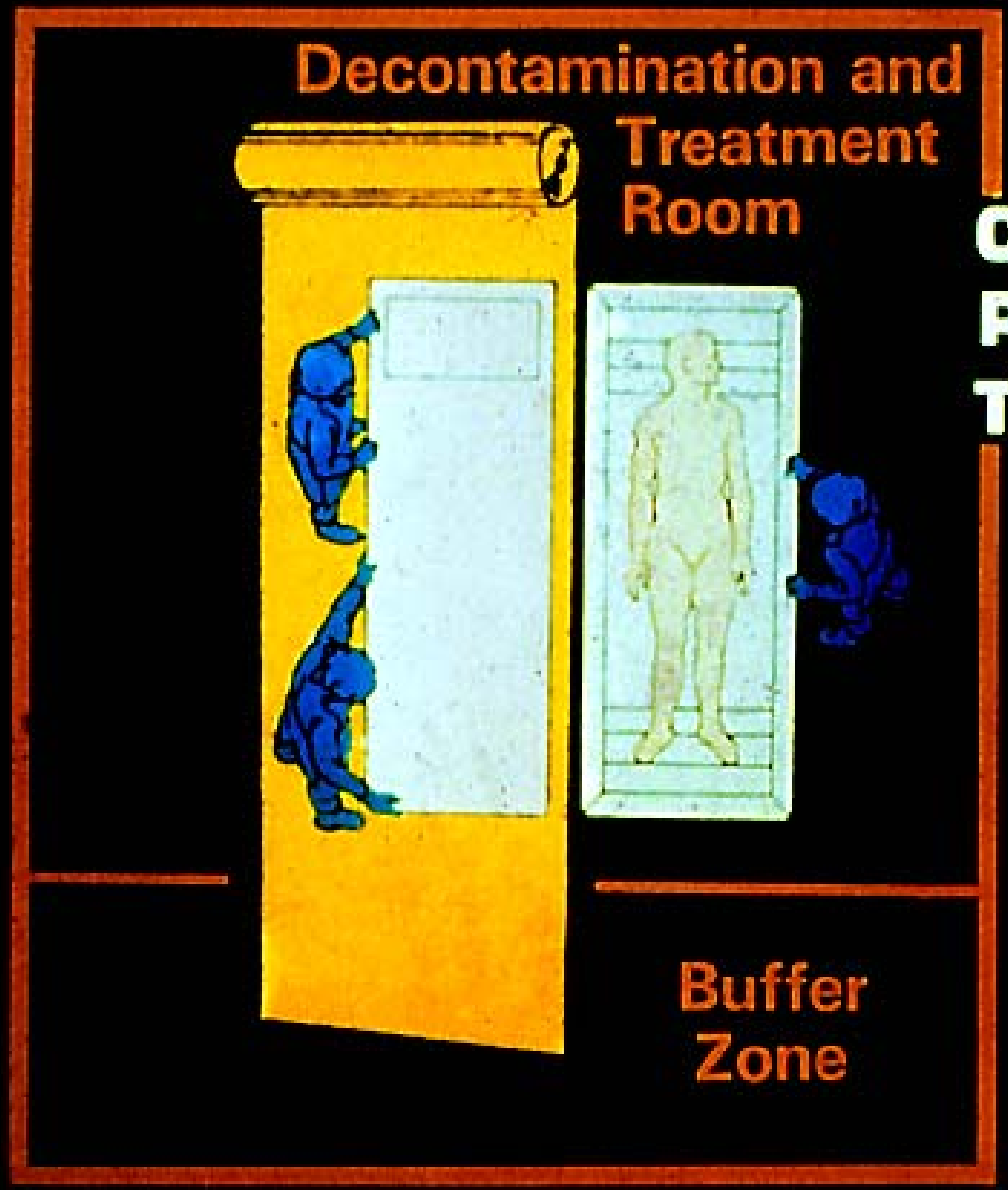
National Council on Radiation Protection and Measurements


CAUTION
STOP
SURVEY
WHOLE
BODY
BEFORE STEPPING
ON THIS
PAD
STOP

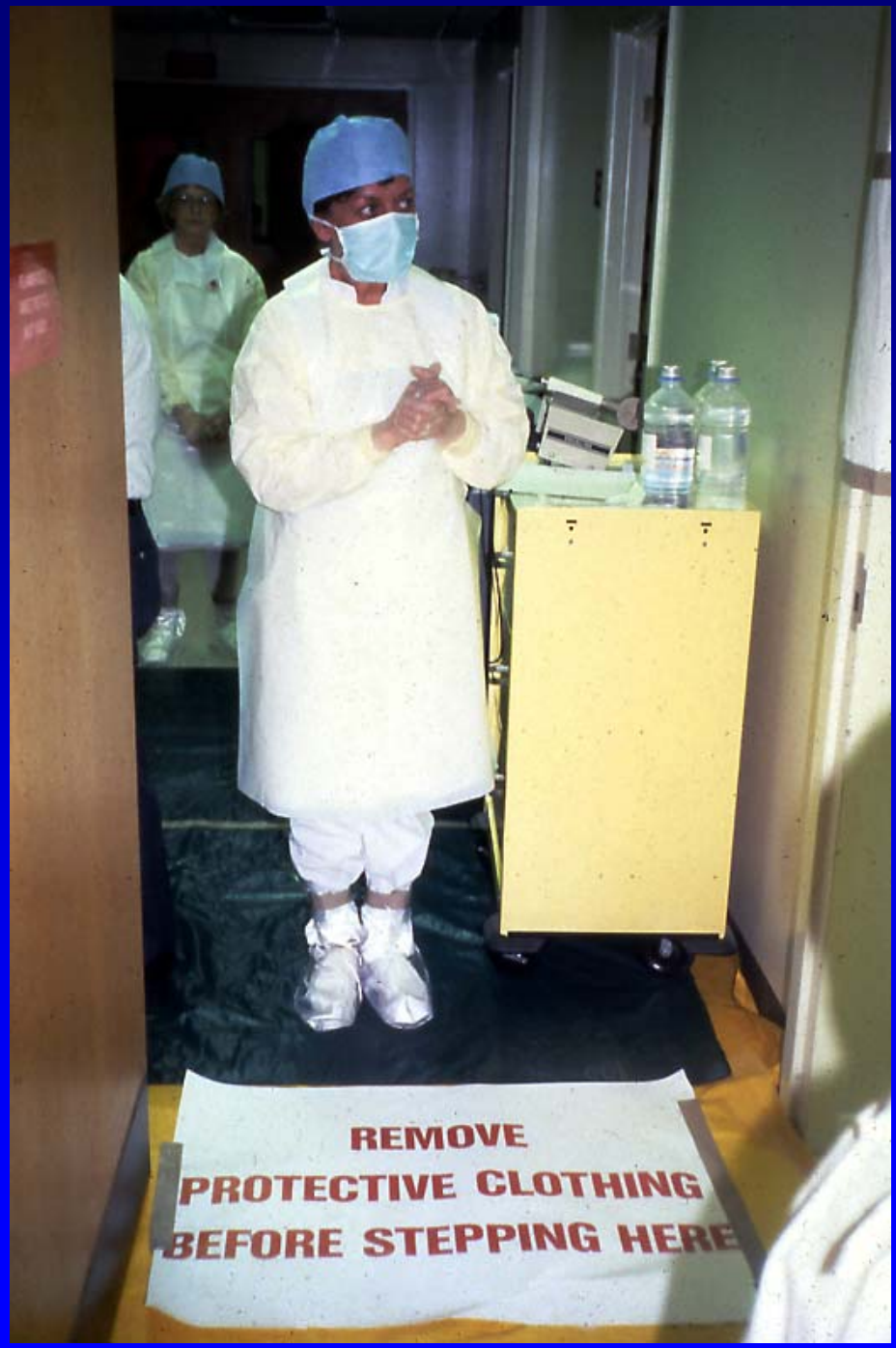



CAUTION


STOP



CONTAMINATED PATIENT TRANSFER


REMOVE
PROTECTIVE CLOTHING
BEFORE STEPPING HERE

RADIATION SURVEY

- Monitor slowly
- Use a reproducible pattern
- Use a constant distance from object
- Protect probe
- Be aware of area background

Facility Recovery

- Remove waste from the Emergency Department and triage area
- Evaluate facility contamination
- Decontaminate as necessary:
  - Normal cleaning routines (mop, strip waxed floors) typically very effective
  - Periodically reassess contamination levels
  - Chelating agents for stubborn contamination
  - Replace furniture, floor tiles etc. that cannot be adequately decontaminated
- Decontamination Goal: Less than twice normal background reading


CAUTION
CONTAMINATION AREA
DO NOT ENTER


M-
823

"Worst" Case Radiation Event Dose Rates

- Exposure only (e.g. 50,000 rads)
  - 0 rads/hr
- Contamination
  - Volitized fuel elements
    - 2.4 rads/hr (e.g. Chernobyl)
  - Metal fragment
    - 25-50 rads/hr or greater

Errors to Avoid in Emergencies

- Forgetting that ABCs come first
- Making external contamination internal
- Making localized contamination generalized
- Delaying treatment of internal contamination
- Lack of proper supplies
- Failing to know when or whom to contact for help

"I'm sure you'll agree, we don't want an epidemic."


RADIATION QUIZ

A Radiological Emergency Will

A. Cause many members of the public to unnecessarily rush to their local ED for evaluation/treatment
B. Generate at least 4 investigative commissions
C. Attract more experts than exist
D. Cause at least 60 scientific publications
E. All of the above